Fact Sheet

REMOTE SENSING/GIS CENTER SHUTTLE IMAGING RADAR (SIR-C/X) SOIL MOISTURE STUDY

PROBLEM

Every year, heavy rains cause emergency situations throughout the United States. Lives and millions of dollars are lost. In many cases, flooding and erosion lead to damage of property and highway systems. Soil moisture data over a wide region are needed for the Corps of Engineers to issue warnings before the occurrence of these events. In-the-field collection of these data is labor-intensive, time-consuming, and costly. Remote sensing is an alternative method for acquisition of soil moisture data.

SOLUTION

The collection of soil moisture data during emergencies usually takes place in cloudy inclement weather. Some in-situ stations are needed for ground truth, but synthetic aperture radar (SAR) offers the best source for synoptic all-weather wide-area coverage. The radar backscatter signature is caused by surface roughness and the dielectric constant of soils, which increases with increasing moisture content. Separated maps of surface roughness and soil moisture content can be made from the radar data and calibrated with the ground truth. These data can be entered into a geographic information system (GIS) and used to predict the distribution of soil water.

RESULTS

The space shuttle Endeavor flew two missions with X-, C-, and L-band SAR in April and October of 1994. The X-band backscatters primarily from surface roughness. The C-band penetrates the first few centimeters of soil and backscatters from surface roughness and volume dielectric. The L-band penetrates deeper into the soil than the C-band and backscatters from surface roughness and average volume dielectric. Surface soil moisture data were obtained from the flood plain near Pool 10 of the Mississippi River during the overflights in April. Surface, 1- and 2-foot-depth soil samples were obtained at a sand-capped landfill near the Merrimac River in Concord, New Hampshire, during four days of overflights in October. Sampling was taken at 30-meter grid points that covered the entire area. To examine a range of moisture values, different parts of the sand site were watered over the four days. To account for the effect of terrain, measurements of slope, aspect and surface roughness were made. To account for ground cover, surface soil samples were also collected at a grass airstrip nearby. Because backscatter is also dependent on the angle of incidence, corner reflectors were installed for calibration. SIR-C/X data have been requested from JPL and a comparison of the radar data to the ground truth is being made.

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